Geology 1020 – section 002 Midterm Examination **Name:_____KEY_____**
Introduction to Geology 2: Historical Geology
I pledge to respect the CU Honor Code (you signature): _____

Please read each question carefully.

There are 21 multiple choice questions on this exam. **Use the exam sheet** and circle the correct answer before you enter the answer in the scantron sheet. There are 3 short answer questions at the end of this exam, **write your answers to the short answer questions on the exam sheet and turn everything in to me, signed, when you are finished**. This exam ends promptly at 1:45pm.

1. This is Midterm Exam Version

   A. A
   B. B
   C. C
   D. D
   E. What??! We have an exam today!!??……..💣…KaaaBoom!

2. Metamorphism of rocks and minerals can cause radiometric systems to act as:

   A. Transformative systems which are independent of D/N ratios
   B. Open systems which alter or reset D/N ratios
   C. Dynamic systems that help define D/N ratios
   D. Closed systems which preserve D/N ratios
   E. Independent systems that are related to D/N ratios

3. Which rocks, from the list below, form from cooling magma?

   A. limestone
   B. basalt
   C. chert
   D. schist
   E. slate

4. Two criteria used in establishing the time "boundaries" in the geologic time scale are:

   A. Principles of superposition and original horizontality with respect to a system.
   B. The sequence of organic evolution and erosional characteristics of the system
   C. Actualism (*or* Uniformitarianism) and Parsimony (a.k.a. *Occam's Razor*)
   D. Plate tectonic movements and deformational episodes of the system.
   E. Unique fossil assemblages and distinctive lithological features of the system.

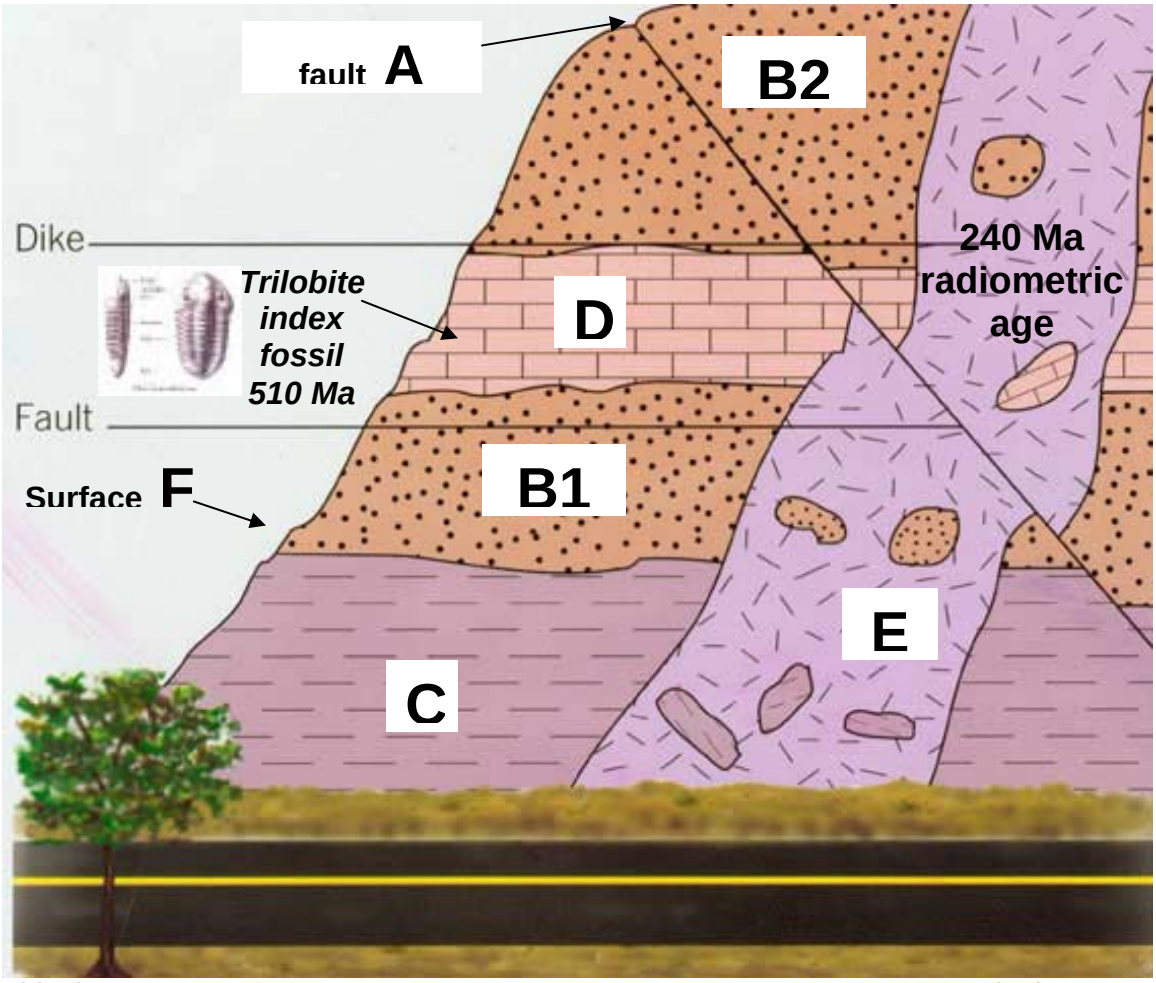
5. Which factor would **NOT** enhance the preservation of fossil remains?

   A. Burial in a low oxygen environment.
   B. Rapid burial by sediments or extrusive materials from a volcano.
   C. The presence of oxygen-tolerant decomposing microbes at deposition.
   D. The presence of hard parts such as bones, teeth and shells.
   E. Co-deposition with fine muds in a shallow lagoonal environment.

6. Plate tectonic processes are driven by:

A. Igneous activity associated with a subducting slab.
B. Primordial heat loss and the decay of radioactive materials within the Earth.
C. Isostatic adjustments of continental crust.
D. Upwelling of deep ocean currents.
E. Climate changes on the Earth's surface causing cooling and heating of crust.

Refer to the **figure** below (and projected on screen) to answer questions 7-11:



This is a RELATIVELY UNDEFORMED & UNMETAMORPHOSED geologic cross-section that appears as a road cut. Now is your time to interpret the history of the rocks.

7. From the cross-section, one can infer **relative age limit(s)** for **stratum B1** as being

A. More than 240 and less than 510 million years old
B. Between 240 and 510 million years old
C. At least older than 510 million years
D. Less than 510 million years old
E. Impossible to determine from this diagram

8. In the diagram, the relative age of **unit E** can be determined using the principles of

A. Horizontality, lateral continuity and components
B. Original lateral continuity and rock type
C. Stratification and uniformitarianism
D. Evolution and natural selection applied to minerals
E. Components, original horizontality and intrusive relationships

9. An unconformity in the stratigraphic record, such as between **unit C** and **unit B1** usually implies

A. a mountain-building event
B. Erosion and subsequent deposition
C. A significant time gap in the geologic record of uncertain duration
D. All of the above are possible explanations
E. An intrusion by a granite dyke

10. Which is the most likely order of geologic events that explains this cross-section?

A. deposition of C, erosion, B1, erosion, B2, D, erosion, E, faulting
B. erosion surface F, B1, D, B2, C, intrusion E, faulting
C. deposition of C, B1, B2, D, E, A, faulting
D. intrusion of E, faulting, A, C, B1, D, B2, erosion
E. deposition of C, B1, D, B2, intrusion E, faulting A, erosion surface F

11. If D/N of unit **E** = 3, what is the half-life of the system you used to determine its age?

A. 4.47 billion years
B. 5370 years
C. 704 million years
D. 120 million years
E. 240 million years

12. A fossil **cast** differs from a fossil **mold** in that

A. Fossil casts are the mirror image of a mold and are often filled with secondary mineralized inorganic materials such as crystalline quartz.
B. Carbon residue sometimes remains on the surface of a cast following the removal of liquid and gaseous components.
C. A mold involves the flattened preservation of the outline and surface features of soft-bodied or semi-hard organisms.
D. Both A and B
E. There is no difference between the two.

13. A sample of zircon, a common radioactive mineral found in many different rocks (formula: $Zr(SiO_4)$), is known from a unit in Western Australia to be approximately 4.228 billion years old. Given that the half-life of ^{235}U is 704 million years, what must the approximate D/N ratio ($^{207}Pb/^{235}U$) of the sample be?

A. 3
B. 15

C. 63
D. 0.999 or about 1
E. 7

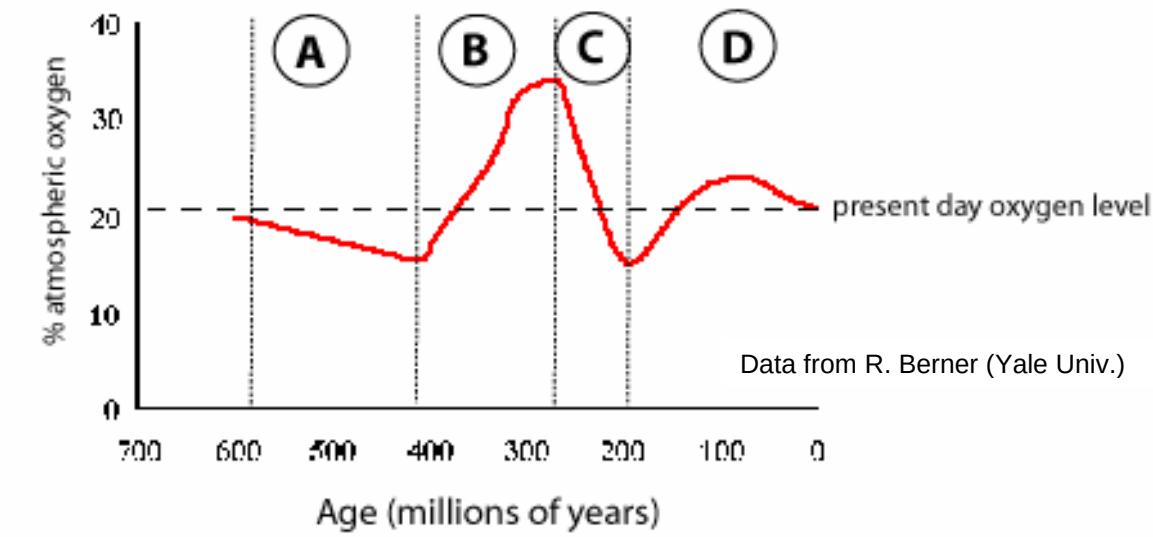
14. When very low burial rates of isotopically light organic material occur in the oceans, the Earth's levels of atmospheric O_2 tends to:

A. Stagnate and lead to widespread asphyxiation of animals and death of plants.
B. Increase because of continued growth of plant populations.
C. Be tied up more readily in the production of carbonate ($CaCO_3$).
D. Decrease because of increased weathering, decomposition, oxidation, etc.
E. Stay the same since there is no relationship between the two processes.

15. When the coupled CO_2-O_2 system on Earth becomes unbalanced due to *(for example*) increases in sediment flux because of tectonic rifting, or because of anoxic stratified ocean conditions, subsequent increases in organic matter burial would result in

A. A reduction in both CO_2 and O_2 levels.
B. Lead to widespread asphyxiation of animals and death of plants.
C. A reduction in Earth's atmospheric CO_2 and an increase in O_2 levels.
D. A reduction in Earth's atmospheric CO_2 and an increase in N_2 levels.
E. An increase in CO_2 and decrease in O_2 levels.

For Questions 16 – 19 *Please refer to the following diagram of Phanerozoic time:



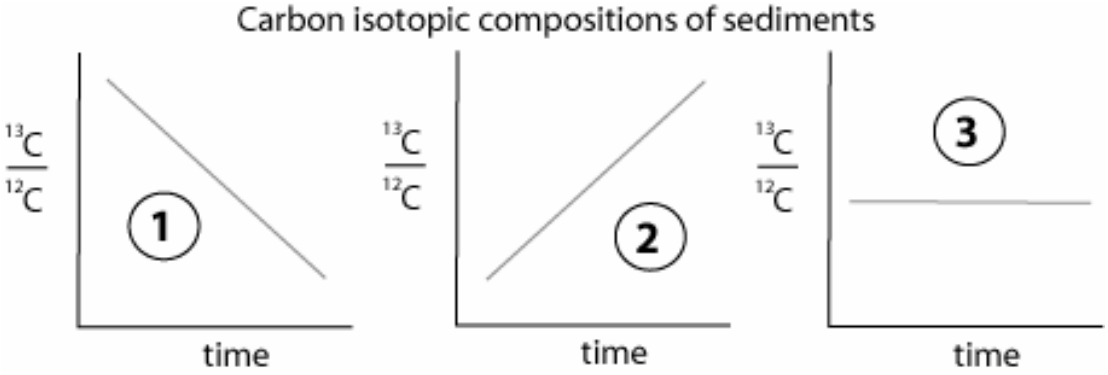
16. Which scenario shown in the diagram above (**A**, **B**, **C** or **D**) best describes the behavior of atmospheric oxygen concentration in Question #15?

A. case **A,** where oxygen is slowly *decreasing*
B. case B, where oxygen is rapidly *increasing*
C. case **C,** where oxygen is rapidly *decreasing*
D. case **D,** where oxygen is near present values (and holding steady)
E. You're kidding, None of the above pertain to Question #15! ☠!!

17. When atmospheric oxygen was at its highest concentration in the diagram, one would expect the Earth's climate at that time to have been

A. slightly warmer than present 400 million years ago
B. same as today 600 million years ago
C. affected by numerous volcanic eruptions
D. highly variable 100 million years ago
E. cooler than present 300 million years ago

18. Below are some isotope diagrams that describe changes in the carbon isotopic composition of organic matter in sediments with time, **in what order would you assign them to each stage of the evolution of carbon dioxide levels in the Phanerozoic atmosphere based on information in the diagram**?



A. **A** (1), **B** (3), **C** (3), **D** (2)

B. **A** (1), **B** (2), **C** (2), **D** (1)

C. **A** (2), **B** (1), **C** (1), **D** (3)

D. A (1), B (2), C (1), D (3)

E. **A** (2), **B** (1), **C** (2), **D** (3)

19. In the Grand Canyon, you collected some sedimentary rock samples from each of the geologic boundaries (vertical dashed lines) of isotopic change in cases A-D in the diagram. With a mass-spectrometer it is possible to determine the ages of these samples with D/N of radioactive isotope systems. If the half-life of the radiogenic system you used is 100 million years, what is the D/N ratio FOR each of the boundaries (oldest to youngest) you measured?

A. <3, 3, 7, >7
B. 63, 15, 7, <3
C. 1, 3, 7, 15
D. 15, 7, 3, 1

E. 63, <15, 1, <1

20. The idea that continents (composed of granite) are less dense (density = 2.7 g cm^{-3}) and "float" on a denser (peridotite) mantle (density = 3.5 g cm^{-3}) is Archimede's principle of

A. Isostasy
B. Superposition
C. Tomography
D. Paleomagnetism
E. Differentiation

21. Which of the following statement(s) is (are) **NOT** supported by the theory of plate tectonics

A. Discrete segments of the Earth's crust move in relation to one another.
B. Continents break apart and fuse together to form larger continents, which results in large-scale rock deformation.
C. Today's ocean basins are now considered to be very old from a geological perspective, older on average than the continents.
D. Volcanoes, earthquakes and huge mountain belts occur along curved belts of seafloor and edges of continents where convergence is taking place (Ring of Fire).
E. Actually, **ALL** of the above statements are supported by the theory! 👍!!

SHORT ANSWER QUESTIONS (do NOT repeat the question in your answer):

22. You have a weird friend who wishes to increase his/her chances of fossilization after death (they want to be a museum exhibit some day). Besides prescription medications, how would you help your friend out?

Here, it was important for you to provide an answer that shows you know a way to preserve information about your friend, as a fossil, in the geologic record. More than this, I was looking for WHY you think the process you propose would work. Finally, the scenario had to be realistic.

23. Briefly discuss how the natural (genotypic) variability of a large population increases its chances of survival in the face of natural selective pressures as compared to a small population of limited diversity. This is the basis of Natural Selection theory.

Large diverse populations contain the genotypic variability that raises the likelihood that favorable traits are present in the face of changing natural selection pressures. These favorable traits therefore have a reasonable chance of being inherited by successful offspring.

24. How are **unstable** isotopes used to establish the **absolute** age of rocks?

Because they have D/N ratios. Specifically, unstable radioactive (parent, N) isotopes decay to daughter (D) isotopes. Given that the rate of decay is invariant, and given that we know the rate of decay, the absolute age of a rock or mineral can be determined by measurement of the D/N ratio.